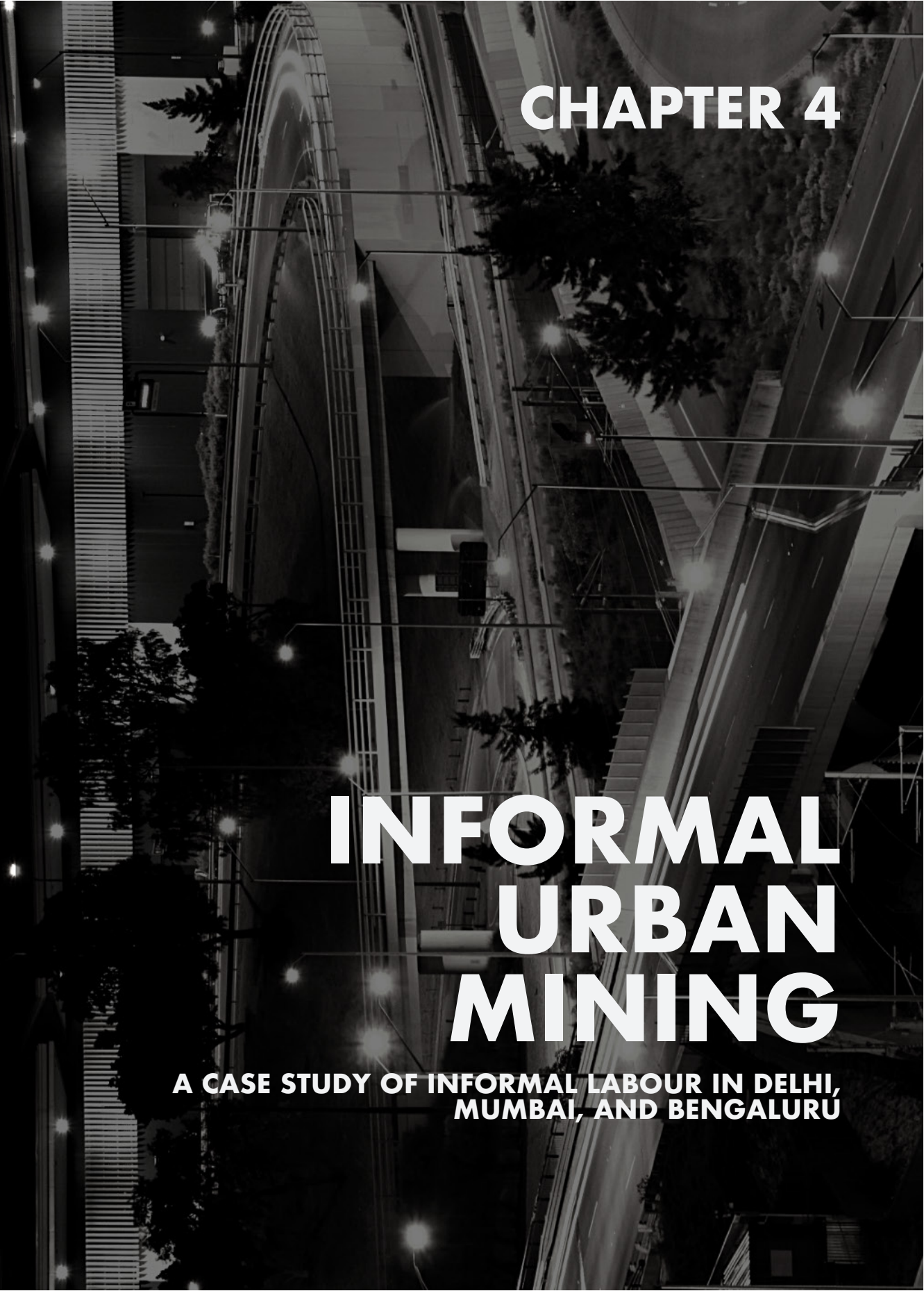

CHAPTER 4

INFORMAL URBAN MINING

A CASE STUDY OF INFORMAL LABOUR IN DELHI, MUMBAI, AND BENGALURU

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A Case Study of Informal Labor in Delhi, Mumbai, and Bengaluru

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ABSTRACT

In this chapter we are looking at urban mining of e-waste (waste of electrical and electronic equipment) in three Indian cities: Bengaluru, Mumbai, and New Delhi. The recycling process is mainly carried out by informal workers in indigent conditions. We aim to understand the informal recycling practices and their effect on the workers, the environment they live in, and the social aspects of being informal recyclers. We use modernization theory, GVC, and Human Development approach. We discover that informal labor is traditional and that the benefit of formal linkages would be the recognition of the presence of informal labor in e-waste management.

INTRODUCTION

In our present society, the use of technology is prevalent and integrated into our lives. A great amount of e-waste is produced in the Western world (Mudali et al., 2021) and ends up in India. The formal recycling facilities of the country are lacking the capacity to process the amount and over 95% of it is handled by informal workers (Dutta & Goel, 2021), who lack the advanced technology for the safe and effective extraction of many precious and earth elements present in e- waste.

Even though formal companies cover only 5% of e-waste recycling in India, they can recycle up to 99% of the components in e-waste. While informal labor reaches up to only 30% (Toxics Link, 2019). If not handled and disposed of properly, e-waste ends up in the environment, contaminating the soil, water, and air. Correct disposal requires access to formal dumping areas, as well as sophisticated processes, to which informal labor does not have access. Therefore, these informal mining activities end up polluting the environment in which the workers themselves live (Toxics Link, 2019). These problems are not encountered by the formal sector. Following the protocol of safety gear at work and using high-tech technologies, formal workers can protect themselves and the environment while extracting more recyclable material.

These two types of labors co-exist and handle the same type of material, but the experience of the workers and the structures of the labor differ greatly. We ask why that is, and what are the conditions and possibilities for improvement for the informal labor in e-waste management.
In this chapter, we will first introduce and detail the topic, and move on to identify the problem area and problem formulation. In the second part of the chapter, we present and explain the concepts and theoretical perspectives which we will use to unpack our research question and to analyze our case. In the operationalization section, we explain how theories are specifically relevant to our analysis. A methodology section explains our choice of methods and process of data sourcing, and we also present the reader with the arguments for validity and reliability of our study. In the analysis section, we employ the theoretical framework to carry out the empirical study. The analysis is built on the three sub-questions, from which we will address our main inquiry. Lastly, we summarize and describe potential future research endeavors for this topic.

1. PROBLEM AREA

In formulating the problem area, we have identified that the recycling process for e-waste is at the crossroads of several factors. These factors, along with how informal e-waste mining impacts them, are briefly discussed below.

Issues with the recycling process: economical
Waste of electrical and electronic equipment (WEEE) is seen as the 'gold' of urban mines. In a context in which technological production is increasingly growing, metals and rare earth elements are precious. E-waste is a secondary resource and is largely recycled by informal workers (over 95% of the recycling) (Dutta & Goel, 2021). There is a striking difference in recovery potential between the formal and informal sectors (Toxics Link, 2019).

Issues with the recycling process: environmental
If not recycled properly, e-waste leeks toxic chemicals, which harms human health and the environment (Mudali et al., 2021). Studies show that the recycling process conducted by Indian informal labor is not efficient and safe (Toxics Link, 2019).

Issues with the recycling process: social
Informal work does not provide social protection and other benefits, leaving workers in situations of precarity, poverty, and uncertainty. On the other hand, WEEE recycling provides them a livelihood, which accounts for the perpetuation of the practice.

Issues with the recycling process: formal labor benefits
Formal companies can extract up to 99% of recyclables and manage their waste in an environment-friendly way.

1.1. Research Question

Our research question departs from these identified issues with the management of e-waste at an informal level, and focuses the discussion on sustainability for this field of urban practice. This chapter seeks to address the question: *How can formalization linkages provide a viable way for sustainable informal urban mining in India?*

Sustainability here is understood as comprised by three dimensions: economical, environmental, and social. This tripartite focus on sustainability helps us structure the following sub-questions:

- How is the economy of informal labor affected by informality?
- How is the environment affected by the informality of informal workers?
- How do the social factors influence the informality of the informal workers?

An assumption here is that formal recycling companies operate at current standards of innovation and technology, while the informal sector relies on more traditional operations, alternative to modern technology. Thus, we analyze the sectors based on the traditional-modern axis, keeping a critical stance to this dichotomy. We are searching for the bridge that would connect these apparently parallel worlds that now exist in the sector of e-waste management in India. Our aim is to discuss the benefits and shortcomings of formalization, at the same time moving away from the Western point of view that argues for a normative approach to modernization, and discover how elements of so-called traditional and modern can co-exist and inform one another, in the Indian context.

1.2. Empirical background and case description

Global e-waste flows and legislation
The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal regulates the movement of hazardous wastes, among which, e-wastes. It aims at diminishing the production of hazardous wastes, promoting their environmentally sound management at a global level, and restricting their transboundary movements (Secretariat of the Basel Convention, 1989). Yet, a great volume of e-waste continues to be shipped illegally to different countries (World Economic Forum, 2019) due in part to the fragmentation and complexity of the regulations worldwide. EEE can move between countries for repair, refurbishment, or re-use, making it difficult to decide whether it is actually waste.

E-waste in India
India is among one of the top countries for e-waste generation, most of which comes from the government and private sectors (Taskar, 2013). The contribution of household appliances to the e- waste in India is about 15% with various types and numbers of white goods and large domestic appliances such as washing machines, dishwashers, etc (Arya & Kumar, 2020). Also, India receives e-waste from developed countries.
E-waste is rich in recyclable, valuable materials. Electronics are comprised out of metal, glass, plastic, and other components. Some may contain up to 60 elements, among which rare earth elements, cheap and precious metals, and poisonous chemicals (Mudali et al., 2021). All these elements can be dismantled and separated, but this might be complicated, depending on the material at hand (Mudali et al., 2021).

Official recycling centers and informal labor
The government of India addresses the issue of e-waste recycling through initiatives for formal recycling centers, yet there is a shortage of them and only a limited portion of the recycling industries undertake the process of value creation through recycling, while many operate solely scrap trading (Mudali et al., 2021).

2. THEORETICAL PERSPECTIVES AND MAIN CONCEPTS

The theoretical section first explains the concepts relevant to understanding our problem and, consequently presents the theories that we use. We choose several theories to gain a well-rounded understanding of the problems identified. In the operationalization sub-section, we connect the concepts and theories with more empirical aspects, to inform the analysis.

2.1. E-waste and Urban Mining

Based on the "Solving the E-waste Problem (Step) Initiative White Paper" electrical and electronic equipment (EEE) is defined as "any household or business item with circuitry or electrical components with power or battery supply" (Step Initiative, 2014). E-waste is the waste of EEE, but its definition is not clear and varies, allowing for its transboundary movement as re-usable materials or second-hand products (Krings, 2015). Urban mining is the process of mining anthropogenic stocks (Cossu & Williams, 2015), among which e-waste is in urban landfills. We use the term with this focus on WEEE.

2.2. Sustainability

The World Commission on Environment and Development, in the Brundtland report from 1987, provided the most accepted definition of sustainability as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (United Nations, 1987). Three dimensions are connected: environmental, economic, and social. These became the pillars of sustainability (planet, profit, and people) which are interdependent and mutually reinforcing (Geissdoerfer et al., 2017).

The report argues that the provision of basic needs and economic growth are strongly intertwined. They are fundamental for long-term environmental sustainability, which calls for a calibrated economy of use and the recycling of non-renewable resources, such as minerals. Sustainable policies should look at the access to resources and the distribution of costs and benefits. In essence, sustainability promotes harmonious integration of resource usage, investment, technological development and institutional policies so to safeguard basic human needs and allow the flourishing of their aspirations, in the present and future (United Nations, 1987).

2.4. Formal and Informal Labor in India

The current definition of informal workers by the ILO comprises all those individuals who work informal jobs, which are characterized by employment relationships not being subject to national labor legislation, income taxation, social protection and/or entitlement to determining employment benefits. Informal workers are also own-account workers operating in their own informal sector enterprise or producing goods for solely own final use, and contributing family workers (ILO, n.d.). The linkages between formal and informal economies are complex and their implications are not obvious. Literature suggests that formal and informal institutional mechanisms and policies influence the linkages between the two sectors (Meagher, 2013).

2.5. Modernization

Theorists in the mid-19th century looked at the difference between 'modern' and 'traditional' society (Gwynne, 2009). Modernization theory has two approaches: economical and sociological (Gwynne, 2009). Ranis and Stewart's (1999) draw a distinction between a modernizing and traditional component of the informal sector. The first is more capital-intensive, integrates a higher level of technology, generally requires more skills, and has higher labor productivity. The second has a low capitalization, labor productivity and income, uses static technology and is often organized inside the household.

From the sociological point of view, we can look at the 5 stages of "modern versus traditional" created by Parsons (1951). He views the social system as a system of roles oriented towards the performance of a specific function that individuals perform based on behavioral models governed by a set of rules. Taking the pattern variables of role-definition (Parsons, 1951):

Affectivity vs affective neutrality: distinct between relations which allows relative immediate gratification of interests by expressive activity compared to relations based on emotional detachment and governed by the discipline of instrumental or moral modes.
Ascription- vs achievement-oriented roles: whether the importance is attributed to ascriptic characteristics (such as class, gender, age and family) or to the actor's performance.
Diffuseness vs specificity: when the role of the actor is spread through a plurality of contexts, differentiated from when it is specific in function and distinctly defined.
Particularistic vs universalistic standards: considers if role-expectations are inspired by particularistic standards and based on the cathectic significance or by universalistic standards, such as universally valid moral concepts and normative rules.
Self-orientation vs collective-orientation: differentiate whether, within a certain role, it is acceptable to act pursuing private interests, or the action should be directed to collective interest.

2.6. Global Value Chain

Global Value Chain (GVC) is a system that envelopes the whole journey of a product, or service provision, from its design, production, sale, to recycling and re-use. The process is driven by lead firms that make decisions throughout the whole chain of a certain product or service. Moreover, they do not necessarily own the factories, nor employ all the people involved in the realization of the product. By being in the same country or overseas, through outsourcing and/or offshoring they raise demands to the companies for the making of their product but are not directly involved in the process (Ponte et al., 2019).

Upgrading
Upgrading is a strategic action that helps firms move up in the value chain. They can do so through various types of upgrading, which are achieved through adding more value to the activities performed by the companies, thus increasing financial gains and markets (Armando et al., 2016).
Economic upgrading looks at how actors may improve their activities to achieve higher economical gain. For this chapter, we are using process upgrading, which focuses on introducing new technology and/or achieving higher efficiency through re-organization of the process.
Social upgrading takes into consideration workers participating in the GVC. It aims to address exploitation at the workplace. It looks at two parameters: measurable standards and enabling rights (qualitative measure, e.g., happiness).
Environmental upgrading refers to changes in activities by lead firms, first-tier and second-tier suppliers that lead to a more environmentally friendly GVC. It has three key drivers: external drivers, emanation from lead firms, and internal drivers.

2.7. Human Development

Human development theory developed on the criticism to views stating that economic growth alone would automatically provide improvement of human wellbeing. Streeten (1993) argues for the plural needs of this approach. It focuses on the eradication of poverty, which would impact positively the expansion of democracy and civil society, social stability, as well as political issues of freedom, governance, justice, and equity. Significant is also that the approach shed a light on the problem of environmental exploitation and degradation. Furthermore, he connects the development of human beings (educated, healthy, happy, skilled, etc.) to an increase in productivity (Streeten, 1993).
Martha Nussbaum (2000) developed the capability approach which defines ten core capabilities, equal in their importance, for the development of human beings. She is concerned with the question: "What are people actually able to do and to be?" People are viewed as an end, namely each and every person is considered valuable and entitled to these fundamental capabilities.
The central human capabilities according to Nussbaum (2000) are:

1. Life, lived to its natural length.
2. Bodily health.
3. Bodily integrity, which is freedom of movement, agency over one own's body and protection against physical violence.
4. Senses, imagination and thought, which are cultivated by education and freedom of expression and religion.
5. Emotions, their expression and safety from distress and traumatic events.
6. Practical reason, alias critical thinking and the formation of the concept of good.
7. Affiliation. A) Possessing the capability for justice and friendship. B) protection of dignity against discrimination and humiliation.
8. Other species, living in relation with nature.
9. Play.
10. Control over one's environment. A) Freedom of political participation. B) Property rights and equality in employment.

2.8. Operationalization

Our chapter is built to consider the three pillars of sustainability: planet, profit, people. Since we are looking at the problem from the perspective of informal labor in e-waste recycling in India, we adjust the pillars to a micro-scale, which leads us to look at the environment that the informal labor workers live in, their economical sustainability, and their place in the society. The pillars are bound with the process of e-waste recycling by the informal workers. We want to understand the influence of the process on the three dimensions of informal labor lives.
In this effort, we apply modernization theory. We will use the perspectives of modernity and traditionality to structure our analysis of how modern or traditional certain aspects of informal labor are considered to be. This will help us better understand the economic implications of informal recycling. Considering the sociological aspect of modernity, we use the pattern variables by Parsons (Gwynne, 2009). These will help us understand if informal labor is leaning towards the modern or traditional side of society. The theory of modernity from both traditional and modern angles, as well as economic and sociological aspects will help us discover the benefits and detriments of formal linkages.

Another framework that we find useful is GVC, specifically upgrading. Informal e-waste recycling in India is part of a global system. Upgrading shows the effects it has once the improvements are made in the process, social welfare, or the environment. Informal labor is not officially part of a company, where upgrading is usually applied. Nevertheless, the framework fits the analysis. Process upgrading shows possibilities and challenges of where the labor appears in GVC once upgraded. Social upgrading reveals what the workers miss simply because they are not officially part of

GVC. It is also a critique to this framework, because it benefits from informality, but is not offering protection. Lastly, environmental upgrading is both beneficial to the workers, as well as the lead firms.

Lastly, we have Human Development. Here we see what modernization theory, as well as the GVC framework, are lacking. It recognizes the relevance of the informal workers' livelihood. The approach focuses on the conditions that allow, and obstacles that impede the full development of human beings. Streeten argues that happy, healthy humans are more productive. Thus, the lower efficiency of the informal sector and workers wellbeing are linked.

3. METHODOLOGY

3.1. Case Study Design

For this chapter we chose a case study design. Case studies require qualitative methods, and contemporary, real-life problem analysis. The phenomena researched needs to be connected to a certain place and time (Saunders et al., 2018). The case that we chose includes three Indian cities: New Delhi, Mumbai, and Bengaluru, which are the biggest cases for e-waste generation and recycling. Another parameter that we add to our problem formulation is informal labor. Informal recycling features in the the core question for our case study. On one hand, e-waste scavenging is a job that workers choose to do, due to several reasons, such as poverty and social caste. On the other hand, the way they recycle is not efficient, leading them to a financial loss, as well as damaging their own health and the environment. Formal recycling centers do not have these types of issues; in its formal operations, e-waste recycling it is profitable, secure for the workers and environment friendly. Our aim is to discover how connecting the formal and informal dimensions would be beneficial for the e-waste scavengers, regarding economic, social, and environmental sustainability.

3.2. Data

To answer our research question, we will be using secondary data. Both qualitative and quantitative sources are useful for this case study. Qualitative data will come from various articles, books and research papers. Quantitative data will come from statistical sources.

3.3. Validity and Reliability

Reliability points to repetition and stability (Saunders et al., 2018). We argue that our research is reliable. Even though it is qualitative research, replicability could be achieved using the same methods. We have a problem question which states what needs to be researched, as well as project design, and these two elements followed by other research would lead them to replicate the case (Elo et al., 2014).
Validity shows that the concept measures the parameters that it is intended to be measured (Babbie, 2014). For this reason, we have introduced the chapter of concepts, explaining what each of them represents to our case. Moreover, validity also refers to generalizability (Saunders et al., 2018). We argue that our analysis can provide generalized insights into similar cases e.g., informal labor in other fields. We achieve that through data and theory triangulation. We use various qualitative and quantitative data sources and include secondary sources that were analyzed using primary research. In theory triangulation, we use the three theoretical perspectives discussed above: modernization, GVC, and human development.

4. ANALYSIS & DISCUSSION

4.1. Process and Informality

The Process of e-waste inflow and recycling
The process of recycling starts with e-waste inflow to the recycling units. Smaller electronics, such as CDs and mobile phones are often thrown with domestic waste, which gets dumped in the cities' landfills. There the rag pickers scour through the heaps of rubbish and collect the waste which is brought to the recycling unit (Taskar, 2013). Bigger electronics cannot be discarded into bins, therefore the door-to-door pickers, also known as kabadiwalas, collect them from homes (Toxics Link, 2019). Municipal garbage collecting cars are issued to gather the waste from residential areas, but they are often late, therefore the citizens are happy with the service provided by the kabadiwalas (Jai Singh Rathore, 2020). Lastly, 28% of the e-waste handled in the informal sector is channeled from formal actors (Toxics Link, 2019).

Once the e-waste is collected and brought to the informal recycling yards and shops, it is inspected. It can either be re-furbished and re-sold, or go through dismantling, recovery, smelting, and recycling. In some scrapyards, one or more of these activities are executed (Toxics Link, 2019). Once the e-waste is processed, it is sold to the dealers based on the material (plastic, copper, circuit boards, etc.). They process the collected parts further and sell them to other places in India, which then sells to foreign buyers (Taskar, 2013).

Modern vs Traditional
We will compare the informal and formal sectors to determine how modern or traditional the informal sector is, or can be perceived to be. According to Ranis and Stewart's (1999) variables, the formal sector is modern. Hence, the formal sector in India will provide us with a measure of what could be considered Indian modernity in the field of e-waste management.

Table 1 shows data for formal e-waste recycling companies.

Location	**M/s Earth Sense** Mumbai, 8 branches in India	**Eco Recycling** Mumbai	**TES-AMM** Bengaluru, Located in more than 20 countries	**Ash Recyclers** Bengaluru	**E-Parisaraa** Bengaluru, 3 units	**Attero Recycling** Delhi
Area	Unknown	Unknown	Unknown	11.000 sq ft	Unknown	Unknown
Employees	30	Unknown	1000	18	Unknown	200-300
Profit	3-5 crores IRS	25 crores IRS	Unknown	Unknown	Unknown	Unknown
Certified	Yes	Yes	Yes	Unknown	Yes	Yes
Tones of material / year	360	Unknown	Unknown	Unknown	8820 (capacity)	36.000 (capacity)
Working hours	Unknown	Unknown	8h/day	Unknown	9 a.m. - 5 p.m.	Unknown
Education	Provides training	Unknown	Provides training	Unknown	Provides training	Provides training
Equipment	Baling machines; Carbon filter; Sizzling machines	High-tech automation	Crushers; Stage scrubbers; Wastewater treatment; Bag filters	Unknown	Hammers; Screwdriver; El. Chisel; Floatation table; Fume hood; Angle grinder; Machines	Hydrometallurgy
Recovery of elements	98%	Unknown	Unknown	Unknown	99%	Unknown

Table 1. Dutta & Goel, 2021

Table 2 shows data for informal labor.

	Informal labor
Location	Well-networked (a), better access to material due to network that is spread through cities (d)
Area	20-40m2 (d), 25-50m2 (d), small open plots (d), small, congested houses (e)
Employees	5000-6000 people in Seelampur area / 1200 shops / 5-6 people in a shop (e)
Profit	A lot of monetary benefit (b), requires very little investment (d), ensure economic sustainability (d), workers are paid per dismantled piece: tube light choke: 0,5 rs; transformer: 20 rs; CPU: 20rs
Certified	Unregulated (a), not authorized by the government, no laws or regulations followed (c), some, financially capable units applied for the authorization, but waiting for response for 2 years (d)
Tones of material / year	Small capacities (a)
Working hours	8 hours (b)
Education	Untrained labor (d), unskilled workers (e)
Equipment	Poor processing technologies (a), crude and rudimentary techniques (b), open burning, blow torch, heat (d), manual (d), electric screwdriver (d), acid baths (d)
Recovery of elements	20-30% (d), huge gap in recycling complex material, low efficiency and recycling of precious metals (d), low handling capacities (c)

Table 2, (a) - Mudali et al., 2020; (b) - Taskar, 2013; (c) - Dutta & Goel, 2021; (d) - Toxic Links, 2019; (e) - Pandey & Govind, 2014.

From the data collected, we can see that capital-intensity is significantly higher in formal settings than informal. There are better opportunities in the formal sector for labor to be more productive due to the access to education and high-tech equipment in formal companies. Hammers and screwdrivers are used by formal and informal labor. This is the only possible measure on which to compare the productivity of each sector. Experience of using them may determine who is more productive. But looking at the entire process of formal companies and scrap dealer's shop, the productivity is higher in formal companies, where they can recover up to 99% of materials from e-waste, while informal shops reach only 20-30%.

The minimum average salary a day in India is 178 Rs (Trading Economics, n.d.). Wages in the secondary sector for regular employees are 357 Rs / day (ILO, 2018). In this case, door-to-door collections pay several times more, that is if they can collect daily. It depends if we compare their incomes as salaries, or incomes as self-employed (which would equal a company). A kabadiwala works independently and any financial loss is felt by them both as a person, and as a company. Workers with salaries do not have to worry about the financial losses of the companies. Workers in the informal sector are not always paid on time (Pandey & Govind, 2014), which deepens the factor of uncertainty and lack of security. It also seems there is a difference between those owning an informal shop and the workers working there. The owners get profits, while the labor employed is struggling (Taskar, 2013).

Equipment is much more technologically advanced in formal companies; it differs based on what each company specializes in. There is a broad range of machines and tools for each step of the process. The informal sector uses manual labor only, and the choice of tools is scarce. The area is bigger in the formal sector. Informal labor is very well connected, so while official units are small shops

and households ranging 20-50m2, one network might eventually cover a bigger area than an official recycling plant. In conclusion, informal sector fits the traditional range of each variable, even though in some we can see the emergence for the need of a clearer definition (e.g., area covered).

Process upgrading
Process upgrading can be achieved through the reorganization of system or technological advancement. Informal labor has a well-organized system: developed networks, landfill search, door-to-door collection, scrap dealers' connections with formal and informal e-waste providers generates "an unlimited supply of ...materials" (Pandey & Govind, 2014, p. 253). From the analysis on whether informal labor is modern or traditional emerges that their technology is underdeveloped. Another fact hinting at a lack of technological advancement is that informal labor is able to extract 20-30%, while formal reaches up to 99% of material extraction. Since each component is worth something, informal recyclers experience profit loss due to processing. Valuable elements, such as precious metals and rare earth elements are barely extracted by informal labor, due to a lack of technological advancement (Toxics Link, 2019).

Obstacles to the control over one's environment capability
Belonging to the lower caste determines obstacles in accessing a property and insecurities in its holding (Dalwai et al., 2019). The condition of illegality of the informal sector do not assure property rights, they can be removed by the authorities, as in the case of workers in Bangalore (Reddy, 2015). Working opportunities are strongly influenced by social factors. Besides being neglected by the government, informal workers have no bargaining power in the business, since there is always another one to replace them (Pandey & Govind, 2014).

In this part we have discussed how the process of informal e-waste recycling is affected by informality from different angles. We see that poverty stems from informal labor being unable to access the riches of e-waste recycling due to the lack of appropriate technology. The most deprived are the workers employed in scrapyards. They have no legal or governmental support in case of mistreatment at the workplace, as well as living daily in financial insecurity. On the other hand, kabadiwalas working on their own possibly earn more than officially employed workers. Scrap- yard owners avoid taxes and fees, due to their informality, as well as exploiting their employees and so capitalizing on profits.

4.2. Environment and Informality
The methods and materials used in informal workshops to dismantle and recycle the e-waste are rudimentary and environmentally unfriendly. Data shows that the informal e-waste workers' desire is to reach the valuable metals as fast as possible. Thus, they use hammering, shredding, burning and acid baths to reach the metals. The process takes place in small workshops, both open and closed, in commercial or residential areas with direct contact with the public. Together all these methods have negative effects on human health as well as on the environment.

Human
Most informal workers are not aware of the health risks and hazards of dealing with e-waste. Taskar (2013) has observed occupational hazards on informal e-waste workers. Interviews in the same manuscript show that informal laborers in India consider cuts and bruises as part of their job (Taskar, 2013). However, as they are working in primitive conditions, the extraction and recycling methods are rudimentary. They do not use personal protective equipment such as gloves, masks, helmets, and gumboot, unlike the formal sector (Toxics Link, 2019). They are being exposed directly to hazardous materials and toxic gases. These cause severe problems in the metabolism, central nervous system, injury to the reproductive system, trigger cancer and constant biotransformation (Vats & Singh, 2014).
Based on World Health Organisation's 2005 report, humans exposed to toxic chemicals face serious health problems, including cancer, liver and kidney dysfunction, immune system suppression,

hormonal imbalance, musculoskeletal disease, premature births, birth defects, sensory system and impeded nervous development, mental health problems, reproductive disorders, genitourinary and cardiovascular diseases, old-age dementia and learning disabilities (McAllister et al., 2014).
Health and economic conditions are directly connected. Poverty increases the health risks as it affects housing, nutrition, and healthcare. Additionally, the condition of the informality of the e-waste workers prevents them from having medical insurance. Thus, they cannot receive proper treatment when having serious health problems (McAllister et al., 2014; Pandey & Govind, 2014). Some scrap dealers store and process e-waste in their homes, hence being constantly exposed to their toxicity (Dutta & Goel, 2021).

One worker interviewed about the training prior to job reports "There is no need to take any training. When you feel hungry, and the stomach cannot take it anymore you will look out for something or other and manage to get something" (Taskar, 2013, p. 18). This example shows that informal e-waste recyclers live in vulnerable conditions and do not get enough good nutrition to have a healthy life. Some of them also do not have shelter and this condition of instability harms their physical and mental health (Taskar, 2013).
Doctors from Delhi who work in an area where informal e-waste recycling is highly performed have reported that health problems in people may be caused by e-waste recycling and burning activities (Pandey & Govind, 2014). The results contain high rate of skin infections, allergic dermatitis, and asthma. Another study takes account of 250 people working as e-waste recyclers and dismantlers over 12 months. It showed that informal e-waste workers have 10-20 times higher levels of lead, mercury and chromium in urine and blood samples and suffer from asthma and bronchitis (Pandey & Govind, 2014).

E-waste components especially affect children and women's morbidity, mortality, and fertility. Women are more sensitive to heavy metals and other toxins, with serious effects on general reproductive and endocrine functions, anemia, hormonal levels, menstrual cycle regularity (McAllister et al., 2014). Being exposed to mercury in the first three months of pregnancy may cause severe problems such as inadequate fetal and neural development, which may cause miscarriage and birth defects. The exposure is likely to continue after the birth, during breastfeeding (McAllister et al., 2014).

Environmental upgrading
As we can see, no measures are taken to prevent environmental pollution, or directly protect workers' health. In this case, we can see environmental downgrading, driven by the internal motive to maximize profit (Mudali et al., 2021). This is applicable both to formal and informal recyclers. Formal recyclers, releasing the e-waste into the informal sector do so due to profit gains as well (Toxics Link, 2019). There are no drivers in the informal recycling sector for environmental upgrading, because they do not exist officially in the GVC.

4.3. Society and Informality

We discover that WEEE informal workers are at the edge of the society and belong to marginalized and vulnerable groups. Caste, class, gender, and other social factors intersect in an intricate network. Most of the workers belong to the lower castes or are part of the Muslim community (Jai Singh Rathore, 2020), they are often poor and uneducated (Dutta & Goel, 2021).

The caste system
The caste system still permeates society and has a durable influence in India (Deshpande, 2011). According to its doctrine, humans were originated from different bodily parts of the divinity (Geetha, 2009), which uphold different value and bestow different caste to different roles in the society. The caste system is founded on principles of structural inequalities and from the clear distinction with the lowest caste. It is perpetuated by endogamy.

Handling waste and polluted materials is associated with the lowest cast, the untouchables (Geetha, 2009) or Dalit, whose body is considered impure. They face multiple and constant ontological forms of exclusion, humiliation, and exploitation. Their marginalization is fundamental to affirm the hierarchy of the caste system itself (Gopal, 2012).
In the WEEE informal economy, labor hierarchies are established based on the caste and ethnical division (Jai Singh Rathore, 2020). A study of one of the bigger informal recycling sites in Delhi found that the recycling units were owned mainly by the Muslim community, while the workers were predominantly low caste Hindus (Pandey & Govind, 2014). Dalit women are at the last step of the hierarchy (McAllister et al., 2014).

Class
Positionality in term of class determines the access possibilities to social goods, such as education and health, to certain professions and land-owning rights (Geetha, 2009), within the caste. Caste is still predominant, and the privileges of the marginalized given by the belonging to a middle or upper middle class is fragile.

Gender
Women hold a lower social status than men (McAllister et al., 2014). Among waste pickers in urban India, a higher percent is female (Raveendran). Women do this job because the earnings and flexible working hours match their role as mothers (McAllister et al., 2014). Compared to men, they work fewer hours per week, have a lower average income (men earn almost 1,5 times more), are older and less educated (Raveendran). The combination of a lower income and a reduced number of hours makes women more likely to be subjected to poverty and reliant on the wage of the male components of the family.
Endogamy and compulsory heteronormativity, upon which the caste system thrives, assign a precise gendered set of roles and expectations (Geetha, 2009) and control over women's body (Gopal, 2012). If these roles are not respected social punishment is dire.

Children
Children are also employed in the informal e-waste sector. In 2013 in Delhi were counted 45.000 children (age 10-14) out of 85.000 total workers in the e-waste informal sector (Pandey & Govind, 2014).

Migration
People from rural areas migrate to the cities, because of lack of local job opportunities determined by the stigmatisation of their caste (Pandey & Govind, 2014). Their condition of externality creates distrust and make them vulnerable to harassment (Hasiru Dala, 2018). Networks of migrants and kinship provide them jobs (Taskar, 2013).

Pattern variables
Considering the pattern variables of Parsons (1951), we do not find clear data to assess the position on all the variables, yet the pervasiveness of social factors in one's life suggests that India presents the characteristics of a traditional society. Roles are oriented towards ascriptic characteristics. Caste, class and gender define the role in society, for instance confining some individuals to recycling jobs in the informal sector. Same goes with social interactions, where the boundaries of roles are undefined, and diffused through multiple contexts. While endogamy and the caste system determine particularistic role-expectations.

A comparison between formal and informal sector is fruitless since it is exactly because of social gatekeeping by the formal sector that individuals find themselves in an informal context. The latter expressed wishes to become formal, but it is hindered by bureaucratic practices and corruption (Taskar, 2013; Toxics Link, 2019).

Capabilities approach
Nussbaum (2000) poses the core question: What are people actually able to do and to be? Through this approach we aim to understand how social factors impede the full flourishing of informal WEEE workers as human beings, which is expressed through the relevant human capabilities.
Caste validates or dismisses certain life decisions in terms of emotional, sexual and professional lives, and family support or obstruct them, to the point where these factors, according to Geetha (2019) "prevents us from literally 'thinking' some choices." Discrimination on the lines of caste, class, and gender is considered legitimate by private sector employers (Deshpande, 2011). Belonging to the lower caste and being a woman are the main impediments to the development of human capabilities. The functioning of the Indian society strongly hinders the development of the central human capabilities.

Social upgrading
Upgrading in the GVC considers regular workers, who are in direct relationship with the employers and can easier negotiate their condition to obtain benefits (Ponte et al., 2019). Two dimensions of this upgrading are measurable standards, namely the improvement in working conditions and enabling rights, which considers the voice of workers, non-discrimination, and freedom of association. Formalization and recognition from the local authorities can equip workers with regulated working standards (i.e., social and legal protection, allocation of recycling spaces) (Jai Singh Rathore, 2020). Cooperatives[1] through the mobilization and union of workers provide representation for the progress of their condition and can secure jobs and salary, furnish basic services and social protection (ILO, 2019). We see some successful improvement of the workers conditions in India, while workers of Bangalore lament they don't see benefits in joining a union (Taskar, 2013). Cooperatives are recognized as a way for formalization, social upgrading, and downgrading.

Formal and informal linkages
Informal e-waste recyclers are stigmatized, as their work is considered dirty and menial (Jai Singh Rathore, 2020; McAllister et al., 2014) and their contribution to the waste management system is not recognized by the city authorities (Arora et al., 2017). Their activity challenges the waste ownership of private firms. Because of their informality and lack of recognition, the workers are not granted legal and social protection from their job.
Social factors play an important role in constraining the informal WEEE recyclers in the informal sector. We already mentioned how these aspects are determinant in the employment possibilities of individuals. A study on employer attitude (Deshpande, 2011) recognized that the social identity of applicants was determinant in the final employment or not. Yet, this was not considered discriminatory by the employers, which saw merit as a natural outcome of social factors (Deshpande, 2011).

This is in accordance with the notion that the upper caste uses its power to maintain the social structure on which its privileges are based (Gopal, 2012). India presents striking levels of inequality (Chancel et al., 2021) and the social and economic mobility of the lower castes is very poor (Deshpande, 2011).
We find that those employed in the formal sector have higher education level compared to informal workers (Dutta & Goel, 2021) and that informal workers operate in the informal sector because it's an available opportunity of livelihood given their poor education (Reddy, 2015). Social factors determine the access to education, which in turn prevent the employment in the formal sector of the most illiterate, securing them to the place assigned by the caste. The transition from informal to formal presents additional obstacles. It would require navigating bureaucracy, applying for the authorization, which may take several years (Toxics Link, 2019), securing the availability of financial resources, planning, and organizational capabilities.

1 "an autonomous association of persons united voluntarily to meet their common economic, social, and cultural needs and aspirations though a jointly-owned and democratically-controlled enterprise" (cooperatives)

Social inequalities determined by being informal could be bettered by enhanced economic opportunities and higher education, which could allow individuals to climb the class ladder and eventually enter the formal sector, which provides social protection and benefits. Yet the marker of the caste persists: "I was called a kabadiwala, still if I talk to people, they look at me as a kabadiwala only" assert the founder of a formal e-waste recycling company in Delhi.

5. CONCLUDING OBSERVATIONS

Formal and informal e-waste recycling sectors benefit from each other. Formal companies release some of the e-waste to informal labor, to cut on costs, which is also financially beneficial for the informal labor. Evidently, informal labor is not able to extract all the possible profits, due to their traditionality. Through process upgrading informal labor could increase their benefits, but that means that it would need to reach the level of formal companies, ie. move from traditional to modern level of technological capability. Even then, they might not succeed due to governmental delays. What modern and traditional patterns do not cover are considerations for environment as a modern variable. This is another aspect at which formal companies excel, and informal labor lags. Informal companies can maximize on profits by avoiding fees and taxes, leading them to greater profit than that of formal labor (Toxics Link, 2019).

However, the question is whether greater profits lead to greater financial sustainability. If people cannot leave a job that pollutes their environment and has adverse effects on their health, are they financially sustainable enough? According to Bruntlands Raport, financial sustainability leads to environmental and social sustainability. Hence, with informal labor being environmentally unsustainable, it could be argued that they are not financially sustainable either. Environmental upgrading could be a consideration for both formal and informal companies. But there are no drivers that would divert informal company to environmentally upgrade. If anything, it seems that downgrading is more beneficial, due to higher profits. On a social level India's traditionality covers both formal and informal sectors, which leads informal sector being deprived of activating their capabilities. Social upgrading seems to be possible for informal labor without becoming former, through cooperatives.

What emerges from reviewed data and discussion of concepts is that formal linkages could prove beneficial if informal labor were recognized in all formal settings. What seems to be triggering the problem is that people working in informal settings are provided the financial resource (e-waste), but no other formal actor sees their informality as beneficial. What formal linkages, such as GVC, formal companies, and the government could provide to informal labor is the recognition that informal labor already exists as an operational dimension of e-waste management.

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